

Distalization with a modified C-palatal plate for severe upper crowding and a missing lower incisor

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This case report presents the orthodontic treatment of a 25-year-old patient with skeletal Class II and severe maxillary arch crowding, moderate mandibular arch crowding, anterior crossbite, and a missing lower incisor. He was treated with molar distalization using a modified C-palatal plate and temporary anchorage devices to create sufficient space for retraction. The total treatment duration was 21 months. After treatment, his occlusion and smile esthetics showed significant improvement. The modified C-palatal plate represents a treatment modality that enhances the prospects of non-extraction treatment and reduces the need for extraction.

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INTRODUCTION

Adult skeletal Class II patients can be treated with upper molar distalization or premolar extraction as a camouflage treatment. Extraction is advantageous for patients with significant crowding and protrusion. However, in cases with severe crowding and retrusive lips, ex-

traction treatment should be carefully evaluated to avoid worsening the patient's profile. If extraction is not an acceptable option to relieve the crowding and proclined incisors, expansion or distalization of the arch should be considered.

Historically, the use of headgear was one of the many successful methods for correction of Class II maloc-

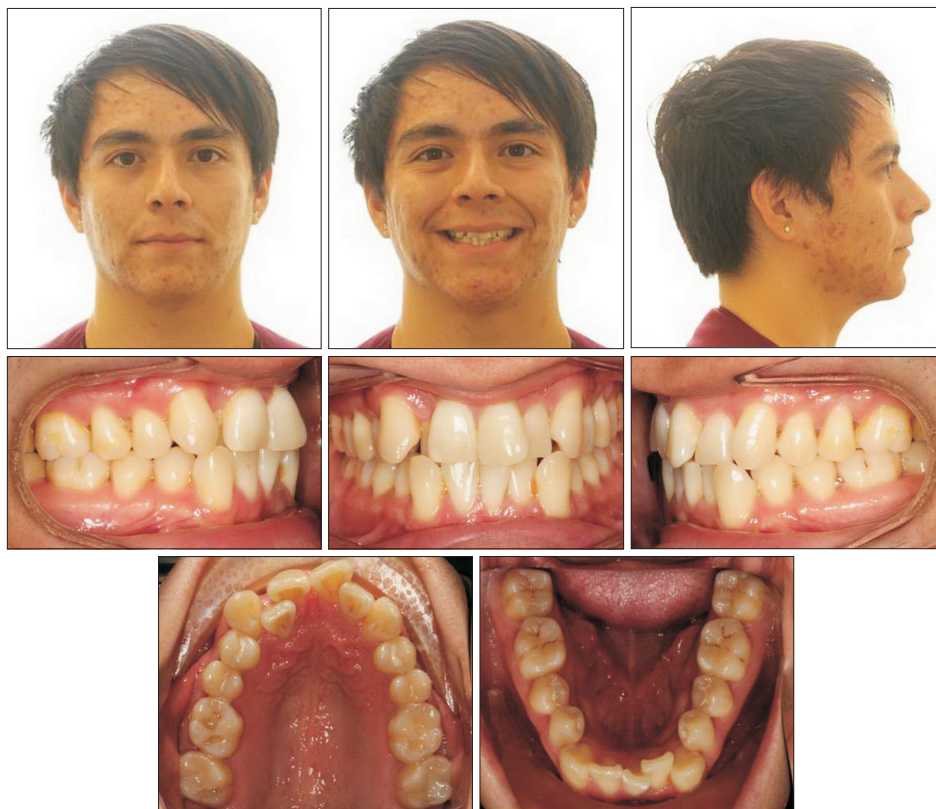


Figure 1. Pre-treatment facial and intraoral photographs.

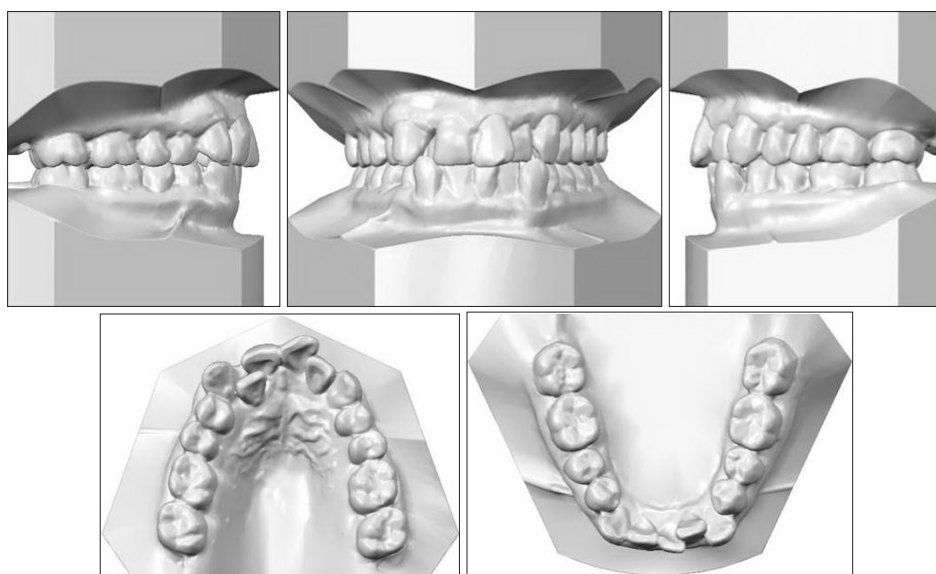


Figure 2. Initial digital models.

clusion; this approach mainly distalizes the maxillary molars to correct dental discrepancies.^{1,2} However, in many cases, patients refuse to wear headgear because of esthetic and social concerns, and the success of this approach primarily depends on patient compliance,³ since a lack of compliance can cause anchorage loss and unsatisfactory treatment results. Dangerous facial injuries are another potential disadvantage of headgear usage.^{4,5} These disadvantages have necessitated the development of other approaches for intraoral molar distalization.

To address this requirement, many intraoral appliances such as push-coils,⁶ pendulums,^{7,8} magnets,^{9,10} distal jets,^{11,12} superelastic nickel-titanium (NiTi) wires,¹³ and molar sliders have been developed for maxillary molar distalization.¹⁴ Although these are extremely useful when they are used for distalization, they are associated with a number of potential disadvantages, including extrusion and rotation of molars, anchorage loss with anterior teeth, and tipping.

Table 1. Cephalometric measurements

Measurement	Norm	Pretreatment	Posttreatment
SNA (°)	82.0	87.2	87.5
SNB (°)	80.0	82.4	83.0
ANB (°)	2.0	4.8	4.5
Wits (mm)	1.0	-3.7	-2.8
SN-MP (°)	34.0	28.5	27.9
FMA (°)	25.0	21.0	19.8
LFH (ANS-Me/ N-ANS) (%)	55.0	57.8	57.6
U1 to SN (°)	104.0	100.2	103.0
U1 to NA (°)	22.0	12.8	13.3
IMPA (°)	90.0	102.9	99.3
L1-NB (°)	25.0	30.9	29.3
U1/L1 (°)	131.0	128.5	131.0
Upper lip (mm)	-4.0	-5.1	-4.9
Lower lip (mm)	-2.0	-2.2	-2.1

SNA, Angle between anterior cranial base (SN) and point A; SNB, angle between SN and point B; ANB, angle between lines NA and NB; Wits, distance between point A and point B on occlusal plane; SN-MP, angle between SN and mandibular plane; FMA, angle between FH plane and mandibular plane; LFH, lower facial height; ANS, anterior nasal spine; Me, menton; N, nasion; U1 to SN, angle between long axis of upper incisor and SN; U1 to NA, angle between long axis of upper incisor and nasion-point A line; IMPA, mandibular incisor angle to mandibular plane; L1-NB, angle between long axis of lower incisor and nasion-point B line; U1/L1, angle between long axis of upper and lower incisors; Upper lip, distance between upper lip and E-line; Lower lip, distance between lower lip and E-line.

More recently, temporary anchorage devices (TADs) have been used to prevent these side effects. In comparison with buccal TADs, palatal TADs offer several advantages such as a lower risk of contacting the roots of adjacent teeth and a wide range of actions not limited by the interradicular space.¹⁵ This report presents the findings for a 25-year-old male patient with severe crowding and retrusive lips and a missing lower incisor who was treated with total arch distalization using a palatal anchorage plate.

DIAGNOSIS AND TREATMENT PLANNING

A 25-year-old man visited the clinic with a primary complaint of upper and lower crowding and a missing lower tooth. His pre-treatment facial profile photographs indicated a convex profile with retrusive lips. An intraoral examination indicated severe and moderate crowding in his maxillary and mandibular arch, respectively. He also had an anterior crossbite on the upper lateral incisors and a Class 1 molar relationship. His maxillary dental midline was 2 mm to the right while his mandibular dental midline was not an issue because of the missing tooth. He did not show any functional shift, and there were no symptoms of temporomandibular disorder. We estimated the width of the missing incisor based on the width of the other incisors. His anterior Bolton ratio was 72% (mandibular deficiency or maxillary excess) (Figures 1 and 2).

The initial radiographic evaluation confirmed the missing incisor and the fact that no third molars were present. It also showed that there were no pathological findings. Lateral cephalometric analysis indicated a

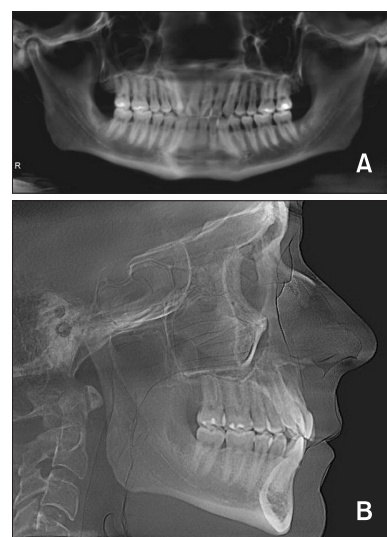


Figure 3. Pre-treatment radiographs. A, Panoramic radiograph; B, lateral cephalogram.

skeletal Class II pattern with a hypodivergent growth pattern (ANB = 4.8°, Wits appraisal = -3.7 mm, and SN-MP = 28.5°). His maxillary incisors were retroclined and his mandibular incisors were proclined (U1-SN = 100.2°, IMPA = 102.9°) (Table 1 and Figure 3).

A treatment plan involving extraction of the maxillary first premolars or maxillary premolars and one mandibular incisor was suggested, but the patient refused it (Figures 4–7). Therefore, we proposed molar distalization using a palatal anchorage plate with TADs to create sufficient space for his lingually displaced maxillary lateral incisors while still maintaining the Class I molar relationship.

TREATMENT OBJECTIVES

The following treatment objectives were established: (1) relieve crowding in both arches, (2) correct anterior crossbite, (3) maintain Class I molar relationship, (4) obtain optimal overjet and overbite, (5) obtain a stable occlusal relationship, and (6) enhance dental and facial esthetics.

TREATMENT PROGRESS

The patient was first referred to a general dentist for treatment of dental caries. Orthodontic treatment was initiated by bonding preadjusted appliances with 0.022-

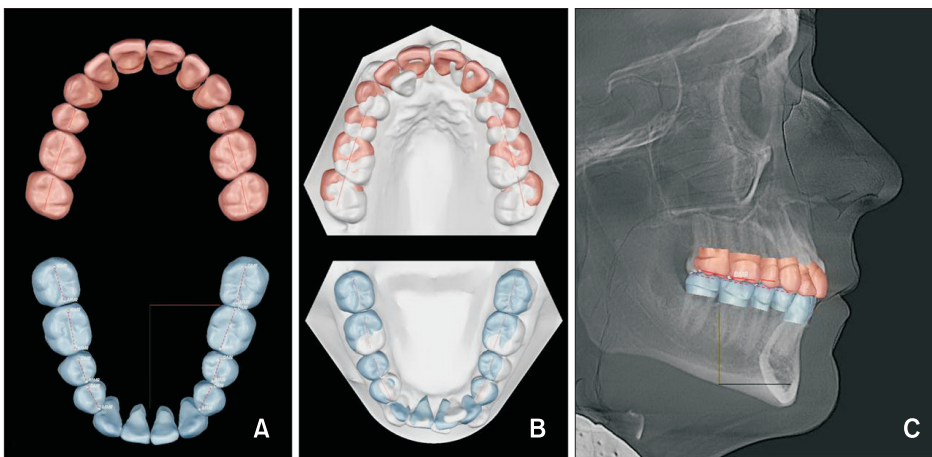


Figure 4. Digital simulations. A, Virtual set-up model for extraction of maxillary first premolars and mandibular incisor. B, Superimposition of the findings before and after simulation. C, Superimposition of three-dimensional crowns on lateral cephalogram (lateral head film aligned to the midsagittal plane of models) (Motion View Software, LLC).

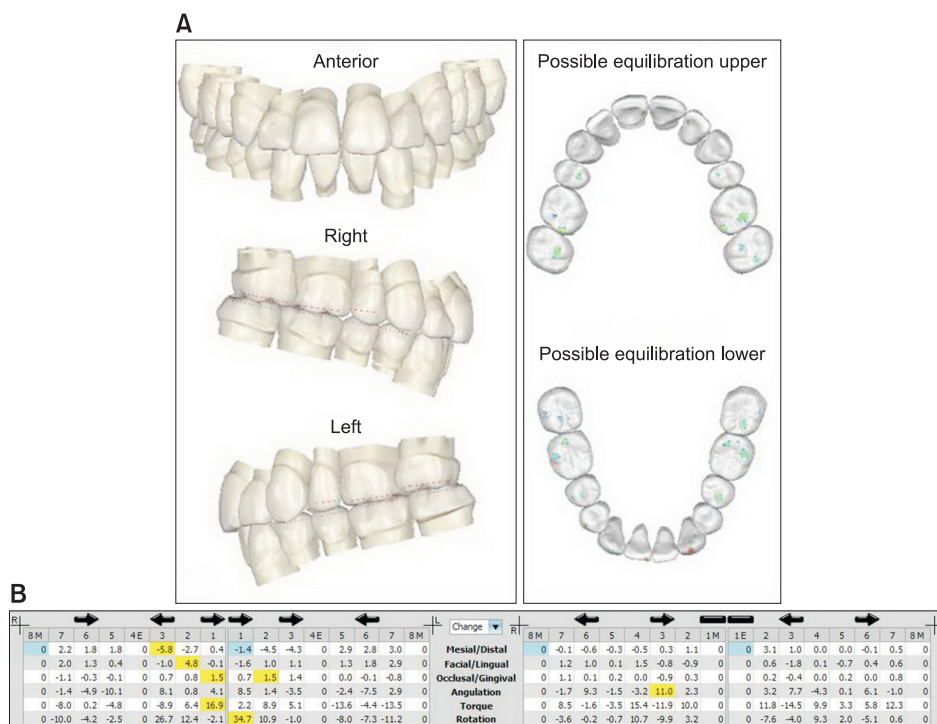


Figure 5. Extraction of maxillary first premolars and mandibular incisor. A, Possible equilibration map. B, Expected tooth movement (Motion View Software, LLC).

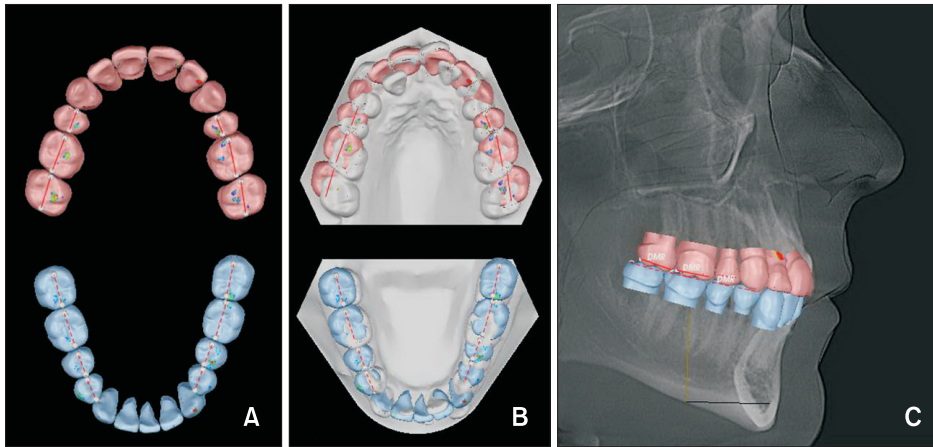


Figure 6. Digital simulations. A, Virtual set-up model for extraction of maxillary first premolars. B, Superimposition of findings before and after simulation. C, Superimposition of three-dimensional crowns on lateral cephalogram (lateral head film aligned to midsagittal plane of models).

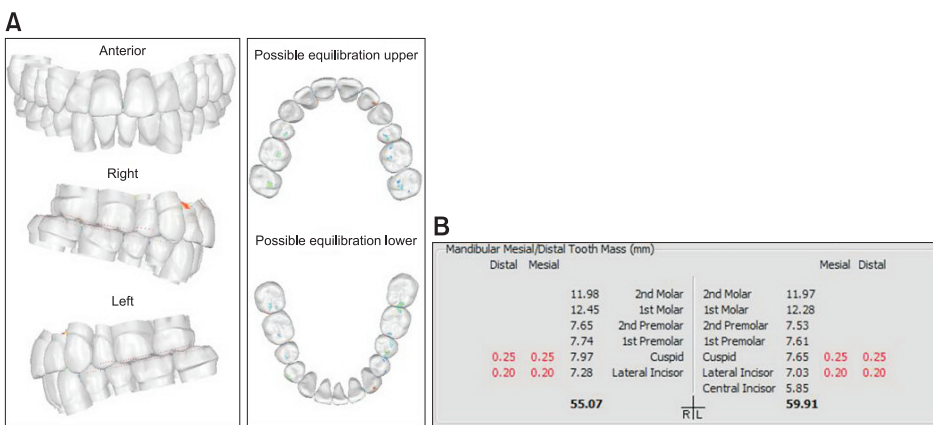


Figure 7. Extraction of maxillary first premolars. A, Possible equilibration map. B, Interproximal reduction to accommodate occlusion. C, Expected tooth movement.

inch (in) slots on both arches for leveling and alignment. The maxillary arch was leveled with archwires, starting with a 0.016-in NiTi archwire and going up to 0.019 × 0.025-in NiTi wires. Under local anesthesia, 8-mm length and 2-mm diameter miniscrews (Jeil Medical, Seoul, Korea) were placed in the three holes of a modified C-palatal plate (MCP), two posterior and one off-set anteriorly, slightly lateral to the midpalatal suture. A stainless steel palatal wire (1 mm in diameter) with anterior hooks was soldered to the maxillary first molar bands, and approximately 250 g of distalizing force was applied between the hooks and the MCP lever arms on each side via elastomeric chains.^{16,17}

Elastomeric chains were connected from the plate to the hooks on the upper palatal bar and retied every two weeks with a 0.017 × 0.025-in stainless steel archwire for a total distalization period of 18 months. Class III elastics were then used for retraction of the mandibular

dentition to achieve a Class I molar relationship. After distalization, the crowding was resolved and the MCP was removed. A panoramic radiograph was then taken and brackets were repositioned to ensure root parallelism. Interproximal reduction of the maxillary and mandibular canine-to-canine was performed to help reduce black triangles and to reduce the maxillary incisor proclination caused by the open coil spring that was used to create space for the blocked-out laterals. Finishing and detailing were performed in conjunction with up-and-down elastics on 0.016 × 0.022-in stainless steel arch wires. Fixed retainers were attached to the anterior teeth, and removable retainers were also delivered to provide secure stability. The total treatment period was 21 months (Figures 8–11).

RESULTS

Post-treatment facial photographs showed improved smile esthetics and a satisfactory overbite and overjet. The patient's Class I canine molar relationships were maintained. A post-treatment panoramic radiograph confirmed acceptable root parallelism despite a dilacer-

ated maxillary right central incisor. There were no significant signs of bone resorption.

Post-treatment lateral cephalometric analysis and superimposition indicated no significant skeletal changes ($ANB = 4.5^\circ$, $SN-MP = 27.9^\circ$) compared to the pre-treatment status. The maxillary incisors showed normal inclination ($U1-SN = 103.0^\circ$), and the mandibular incisor

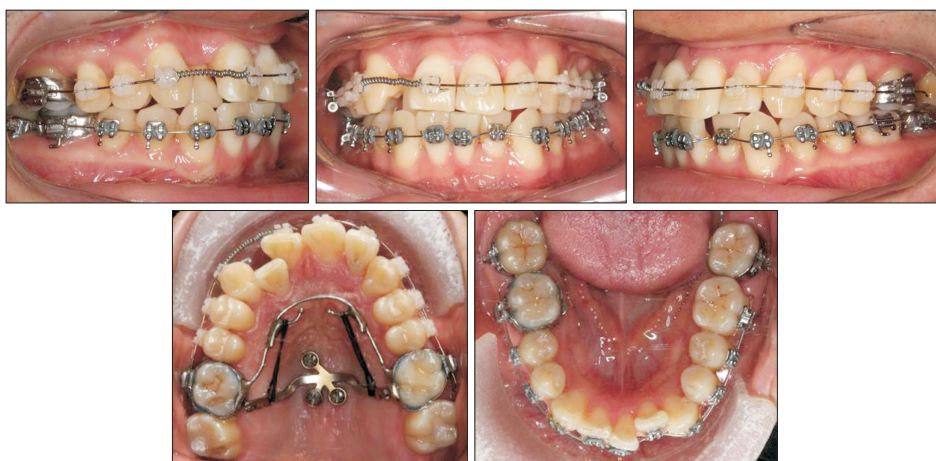


Figure 8. Full-arch distalization of the maxillary arch (after 6 months of distalization).

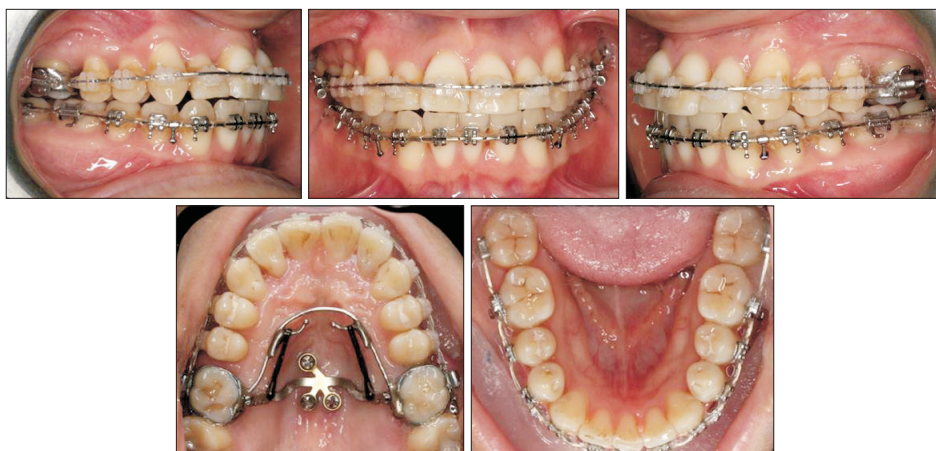


Figure 9. Full-arch distalization of the maxillary arch (after 12 months of distalization). During the distalization of the maxillary arch, Class III elastics were engaged on the right side to establish Class I relationship and triangular elastics from the upper canine to lower canine and the first premolar on the left side.



Figure 10. Intraoral photographs showing the treatment progress (after 17 months of distalization).

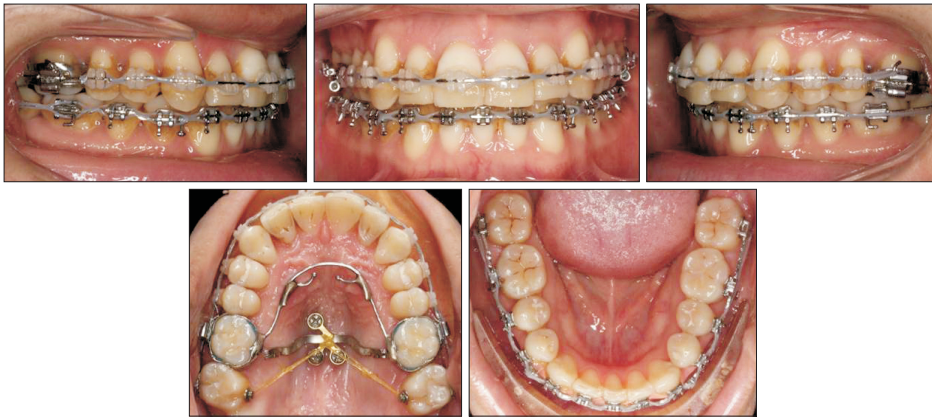


Figure 11. Intraoral photographs showing the treatment progress (after 21 months of treatment). The lingual buttons attached to the maxillary second molars were engaged to the palatal plate to express lingual crown torque along with the torque in the 0.019 × 0.025-inch stainless steel wire.

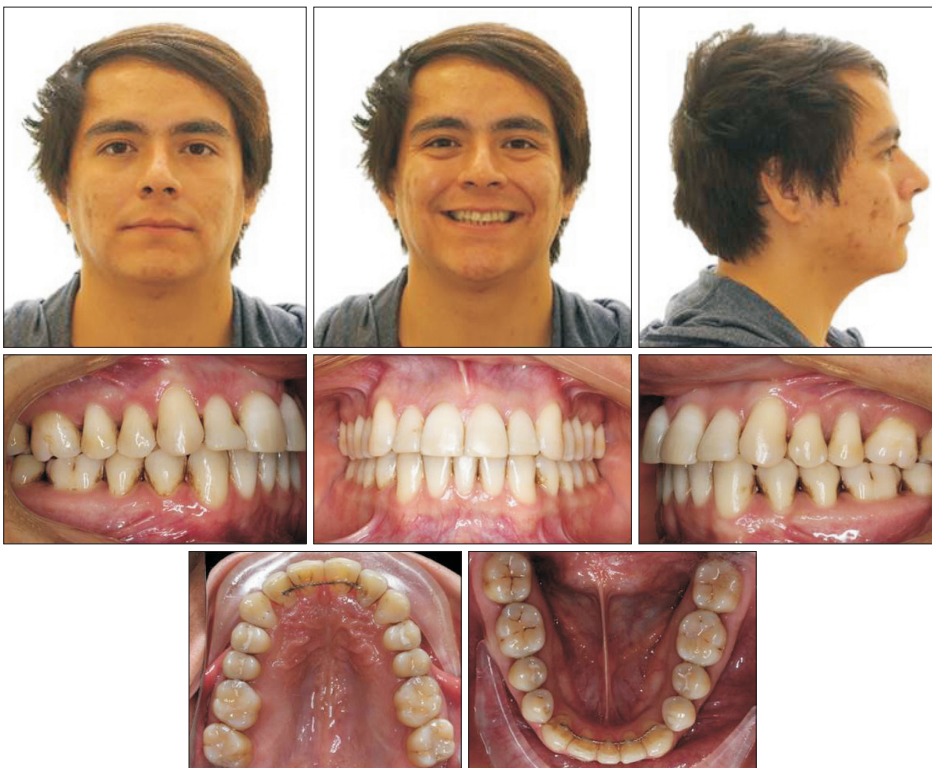


Figure 12. Post-treatment facial and intraoral photographs (after 24 months of treatment).

inclination had improved (pre-treatment IMPA = 102.9°, post-treatment IMPA = 99.3°). The patient's maxillary molars were distalized successfully with 4.2° of distal tipping measured from the Frankfort horizontal. There was no significant extrusion. The patient reported no temporomandibular joint pain or discomfort during or after orthodontic treatment. His American Board of Orthodontics cast-radiograph evaluation score was 14 (Figures 12–18).

DISCUSSION

The esthetic and social concerns associated with headgear use for molar distalization have motivated

many clinicians to consider other molar distalization techniques.^{4,6-14} Intraoral distalization appliances are a plausible alternative but can cause an unavoidable, adverse, reciprocal mesial movement of the anterior teeth and premolars during distal movement of the molars. After regaining the space with molar distalization, the anterior teeth and premolars that initially moved forward should be retracted. However, the molars that were already distalized are used as anchorage for retraction of the anterior teeth, which causes them to move anteriorly and thus reduce the efficiency of the distalization.¹⁸

Skeletal anchorage systems have been employed as an alternative treatment modality in orthodontics over the past two decades.¹⁹⁻²¹ One of the most important appli-

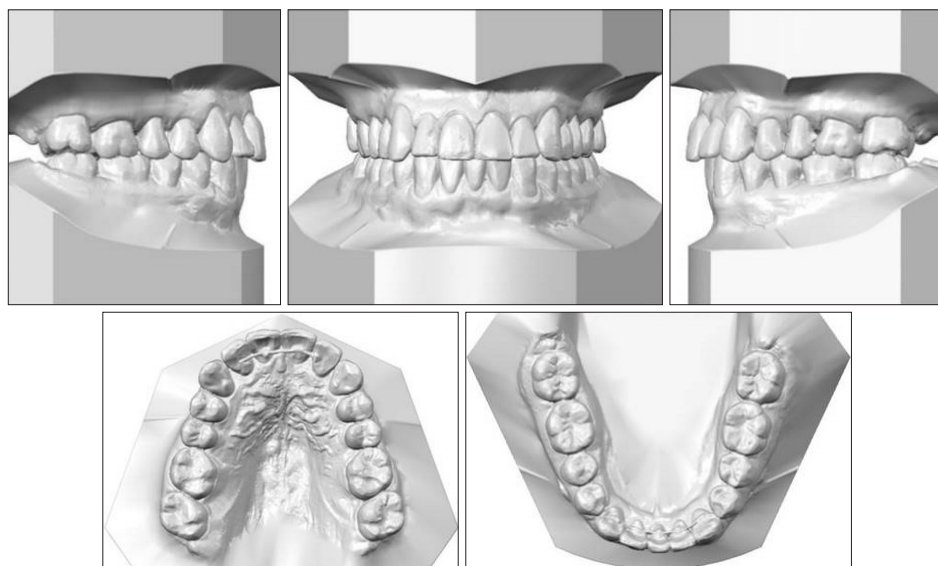


Figure 13. Post-treatment digital models.

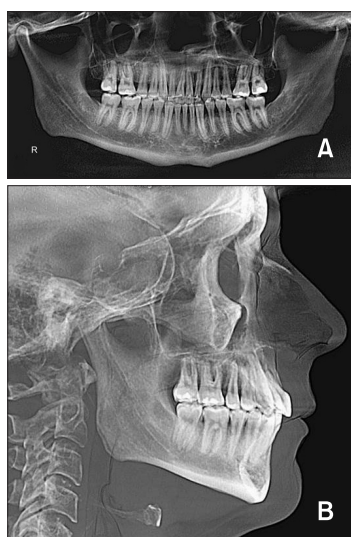


Figure 14. Post-treatment radiographs. A, Panoramic radiograph; B, lateral cephalogram.

cations of skeletal anchorage systems is molar distalization. The major advantages of using TADs for distalization, in comparison with conventional treatment that uses headgear or intraoral appliances, are the lack of esthetic impairment and preservation of the anchorage during distalization of the molars.

Park et al.²² found that all maxillary teeth showed intrusion and distal tipping during molar distalization with buccal miniscrews. These effects were attributed to the limited control over retraction force vectors. However, with MCPs, superior control over the force vectors can be obtained through several notches on the plate, which makes it more versatile. The extent of intrusion and tipping is controlled by engaging elastics in the appropriate

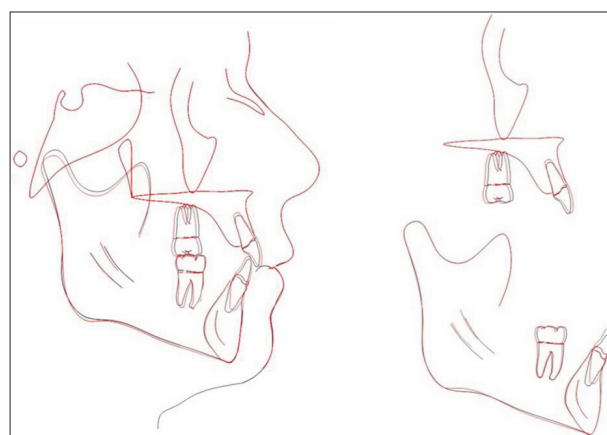


Figure 15. Cephalometric superimposition. Black, Pre-treatment; Red, post-treatment.

notches.²³ Furthermore, they allow teeth to be moved farther without requiring relocation of the miniscrews.

Distalization of the entire maxillary dentition requires the application of a 450 to 500 g force. Since a single miniscrew cannot withstand such heavy forces,²⁴ MCPs are anchored with three miniscrews. Considering a 2.5-mm-high screw tube and 8-mm-long miniscrew, the net length of the miniscrew that is embedded in palatal bone is 5.5 mm. Ryu et al.²⁵ reported that the palatal bone thickness in the permanent dentition is 5.5 mm in the midpalate and 5.9 mm in the posterior palate, making penetration of the nasal cavity unlikely. The palatal approach might also be a crucial component in achieving bodily movement without extrusion of the molars.²⁶ Yu et al.²⁷ reported that the rate of distal tipping and extrusion in palatal plate cases was lower than that with buccal miniscrews. According to the reported case, the

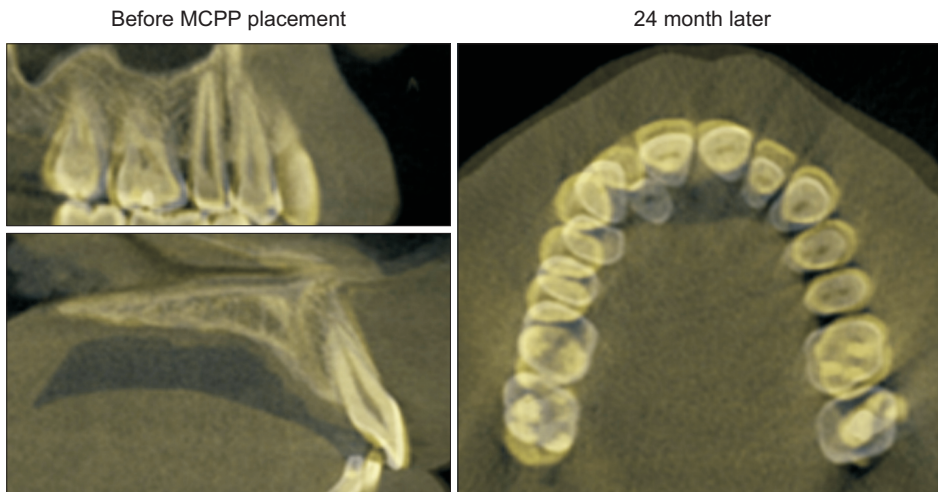


Figure 16. Cone-beam computed tomography superimposition before and after maxillary total arch distalization (before, gray; after, yellow). MCPP, Modified C-palatal plate.

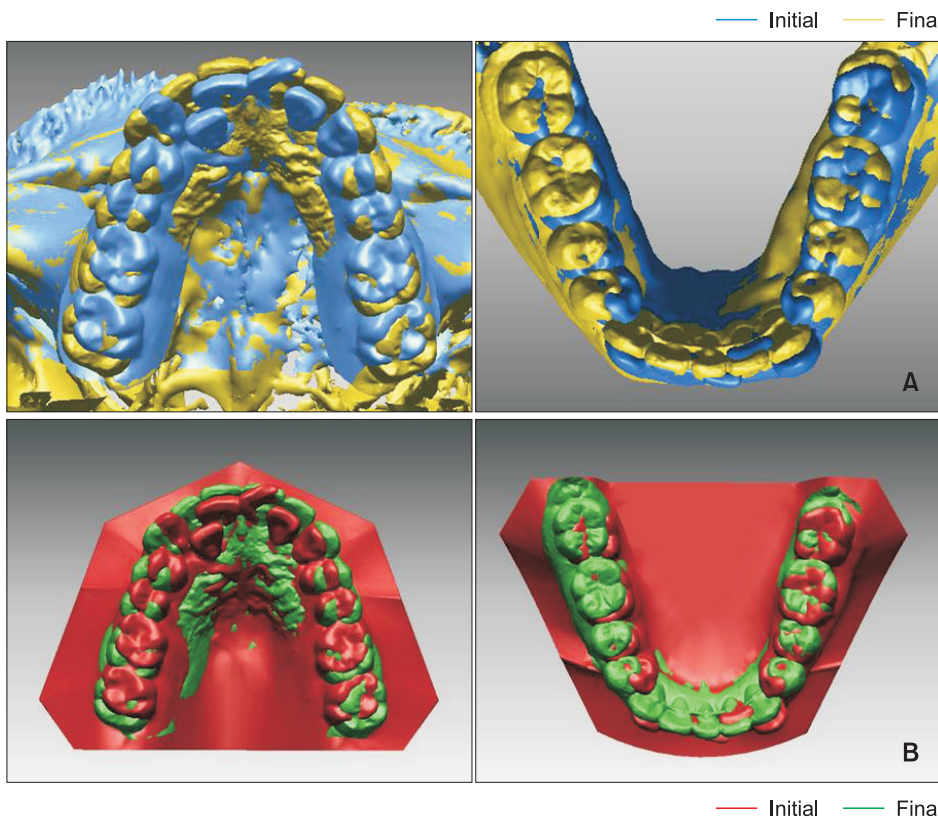


Figure 17. Superimpositions before and after cone-beam computed tomography and digital model superimposition (Orapix system; Cenox Co., Ltd.). A, Cone-beam computed tomography images (blue, initial; yellow, final). B, Digital model images (red, initial; green, final).

distal tipping was about 4°.

The thickness of palatal bone and soft tissue can usually support TADs in adults and adolescents. The most appropriate regions in the palate for TAD placement have been adequately described in previous studies.^{25,28} Recently, the treatment effects of palatal plates in distalization of the maxillary dentition in adults and adolescents was evaluated comprehensively by Kook et al.²⁹ MCPP can be an effective appliance for maxillary distalization without significant side effects for patients who

refuse to undergo extraction treatment.

CONCLUSION

The palate is a safe site for TAD installation because of its appropriate characteristics such as bone quantity and quality and soft tissue thickness. The application procedure is minimally invasive and short in duration. Molars can be distalized efficiently without loss of anchorage or any significant tipping. No cooperation is

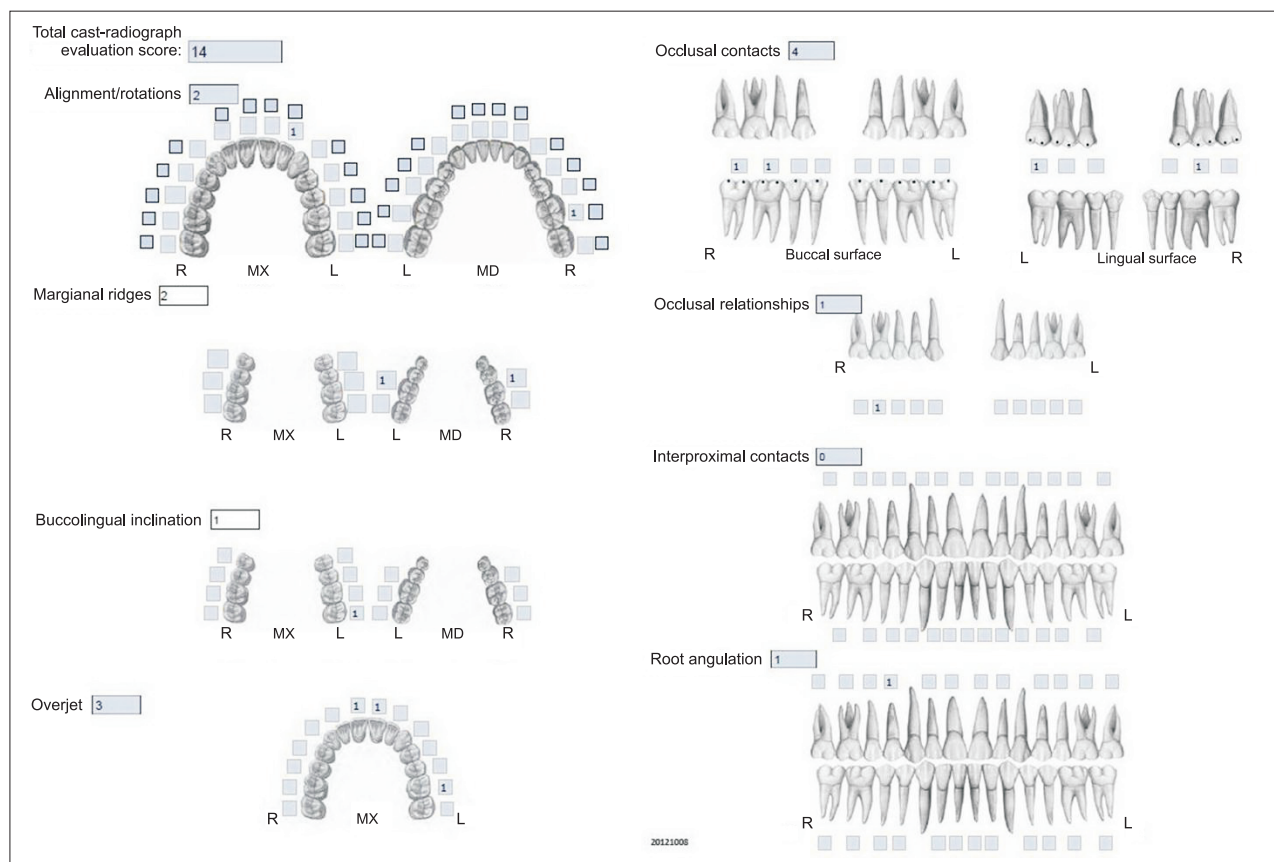


Figure 18. American Board of Orthodontics cast-radiograph evaluation score.

required other than good oral hygiene with MCP. This is a simple and effective nonextraction approach for distalization of the maxillary dentition with a relatively true bodily movement of the maxillary first molars.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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